

CLAIMS

I claim,

1 1. A flow-based analysis system connectable to a sample source,
2 the system comprising:

3 a stream selection device coupleable to the sample source to receive
4 a selected sample;

5 a fluid propulsion device in fluid communication with the stream
6 selection device and positioned to move a flow of fluid to and from the stream
7 selection device;

8 a detector in fluid communication with the stream selection device
9 and positioned to receive a sample flow for analysis;

10 a reagent cartridge assembly in fluid communication with the stream
11 selection device, the reagent cartridge assembly having

12 a cartridge support coupled to the stream selection device;

13 a reagent conduit connected to the cartridge support and in
14 fluid communication with the stream selection device;

15 a reagent cartridge removably attached to the cartridge
16 support, the reagent cartridge having a reagent reservoir therein sized to contain a
17 selected reagent, the reagent reservoir being in fluid communication with the
18 reagent conduit when the reagent cartridge is installed on the cartridge support;
19 and

20 a controller operatively connected to the stream selection device and
21 configured to control the flow of fluid to or from the reagent cartridge assembly
22 and to the detector.

1 2. The flow-based analysis system of claim 1 wherein the
2 reagent cartridge assembly includes a plurality of reagent conduits connected to
3 the cartridge support, and the reagent cartridge contains a plurality of reagent
4 reservoirs each in fluid communication with a respective one of the reagent
5 conduits when the reagent cartridge is installed on the cartridge support.

1 3. The flow-based analysis system of claim 1 wherein the
2 reagent cartridge assembly is removably coupled to the stream selection device.

1 112 4. The flow-based analysis system of claim 1 wherein the
2 reagent cartridge is a disposable cartridge.

1 5. The flow-based analysis system of claim 1 wherein the
2 reagent conduit is a hollow needle sized to removably extend into the reagent
3 reservoir when the reagent cartridge is installed on the cartridge support.

1 6. The flow-based analysis system of claim 1 wherein the
2 reagent reservoir includes an open end portion and a penetrable septa extending
3 across the open end portion, and the reagent conduit is positioned to penetrate the
4 penetrable septa and extend into the reagent reservoir when the reagent cartridge is
5 installed on the cartridge support.

1 7. The flow-based analysis system of claim 1 wherein reagent
2 cartridge assembly includes an alignment member positioned to align the reagent
3 cartridge with the reagent conduit as the reagent cartridge is installed in the
4 cartridge support.

1 8. The flow-based analysis system of claim 1 wherein the
2 reagent cartridge assembly includes a pair of alignment rods attached to the
3 cartridge support and the reagent cartridge having a pair of alignment apertures
4 shaped and sized to removably receive the alignment rods and align the reagent
5 cartridge with the reagent conduit when the reagent cartridge is installed on the
6 cartridge support.

1 9. The flow-based analysis system of claim 1, wherein the
2 reagent cartridge contains a reagent in the reagent reservoir, and the reservoir
3 cartridge includes a machine readable identifier with information related to the
4 reagent on a selected analysis method.

1 10. The flow-based analysis system of claim 1 wherein the fluid
2 propulsion device is a pump.

1 11. The flow-based analysis system of claim 1 wherein the
2 reagent cartridge contains a lyophilized reagent therein that is one of a lyophilized
3 reagent, a concentrated reagent, and a non-concentrated reagent.

1 12. The injection analysis system of claim 1 wherein the
2 controller includes a central processing unit and a sequence controller.

1 13. A sequential injection analysis (SIA) system connectable to a
2 fluid source, comprising:
3 a stream selection device coupleable to the fluid source to receive a
4 selected fluid;

5 a pump coupled to the stream selection device and positioned to
6 move a flow of fluid to or from the stream selection device;

7 a detector coupled to the stream selection device and positioned to
8 receive the sample flow for analysis;

9 a reagent cartridge assembly coupled to the stream selection device
10 and positioned to provide a selected reagent to the sample flow, the reagent
11 cartridge assembly having

12 a cartridge support;

13 a plurality of hollow needles connected to the cartridge
14 support and in fluid communication with the stream selection device;

15 a reagent cartridge removably attached to the cartridge
16 support, the reagent cartridge having a plurality of reagent reservoirs therein sized
17 to contain at least one reagent, each reagent reservoir being in fluid
18 communication with a respective one of the hollow needles when the reagent
19 cartridge is installed on the cartridge support; and

20 a controller operatively connected to the stream selection device to
21 control the flow of fluid to or from the reagent cartridge assembly and to the
22 detector.

1 14. The SIA system of claim 13, wherein the cartridge support
2 slidably receives the reagent cartridge therein.

1 112 15. The SIA system of claim 13 wherein the reagent cartridge is a
2 disposable cartridge.

1 112 16. The SIA system of claim 13 wherein the reagent cartridge is a
2 re-useable cartridge.

1 17. The SIA system of claim 13 where the pump, detector, and
2 reagent controller are couple to the stream selection device with small-bore tubing.

1 18. The SIA system of claim 13 wherein the reagent cartridge
2 assembly is removably connected to the stream selection device by a fluid conduit.

1 19. The SIA system of claim 13 wherein each reagent reservoir
2 includes a dispensing end portion and a penetrable septa extends across each
3 dispensing end portion, and each hollow needle is positioned to penetrate the
4 penetrable septa of the respective reagent reservoir and extend into the reagent
5 reservoir when the reagent cartridge is installed on the cartridge support.

1 20. The SIA system of claim 19 wherein each reagent reservoir
2 includes porous frit spaced apart from the dispensing end portion, and the hollow
3 needle extends into the reagent reservoir to a position adjacent to the frit.

1 21. The SIA system of claim 13 wherein reagent cartridge
2 assembly includes an alignment member positioned to align the reagent cartridge
3 with the reaction reservoirs in alignment with the respective needles as the reagent
4 cartridge is installed on the cartridge support.

1 22. The SIA system of claim 13 wherein the reagent cartridge
2 assembly includes a pair of alignment rods attached to the cartridge support, and
3 the reagent cartridge has a pair of alignment apertures shaped and sized to
4 removably receive the alignment rods and align the reagent reservoirs with the
5 needles when the reagent cartridge is installed on the cartridge support.

1 23. The SIA system of claim 13 wherein the reagent cartridge
2 contains one or more reagents in the reagent reservoirs, and the reservoir cartridge
3 includes machine readable symbology that provides information related to the one
4 or more reagents.

1 24. The SIA system of claim 13 wherein the reagent cartridge is a
2 unitary member and all of the reagent reservoirs are formed in the unitary member.

1 25. A reagent cartridge assembly for use with a sequence
2 injection analysis (SIA) testing system having a multi-position stream selection
3 device coupled to an analyzer, comprising:

4 a cartridge support;

5 a plurality of hollow needles connected to the cartridge support and
6 coupleable to the SIA testing system in fluid communication with the stream
7 selection device; and

8 a reagent cartridge removably attached to the cartridge support, the
9 reagent cartridge having a plurality of reagent reservoirs therein shaped and sized
10 to contain at least one selected reagent, each reagent reservoir being in fluid
11 communication with a respective one of the hollow needles when the reagent
12 cartridge is installed on the cartridge support.

1 26. The reagent cartridge assembly of claim 25 wherein the
2 cartridge support slidably receives the reagent cartridge therein.

1 112 27. The reagent cartridge assembly of claim 25 wherein the
2 reagent cartridge is a disposable cartridge.

1 28. The reagent cartridge assembly of claim 25 wherein each
2 reagent reservoir includes a dispensing end portion and a penetrable septa extends
3 across each dispensing end portion, and each hollow needle is positioned to
4 penetrate the penetrable septa of the respective reagent reservoir and extend into
5 the reagent reservoir when the reagent cartridge is installed on the cartridge
6 support.

1 29. The reagent cartridge assembly of claim 25 wherein each
2 reagent reservoir includes porous frit spaced apart from the dispensing end portion,
3 and the hollow needle extends into the reagent cartridge to a position adjacent to
4 the frit.

1 30. The reagent cartridge assembly of claim 25 further including
2 an alignment member positioned to align the reagent cartridge with the reaction
3 reservoirs aligned with the respective needles as the reagent cartridge is installed
4 in the cartridge support.

1 31. The reagent cartridge assembly of claim 25 wherein the
2 reagent cartridge contains one or more reagents in the reagent reservoirs, and the
3 reservoir cartridge includes machine readable indicia that provides information
4 related to the one or more reagents.

1 32. A method of analyzing a plurality of samples using sequential
2 injection analysis, comprising:
3 positioning a stream selection device in a first position in fluid
4 communication with a first fluid source;

5 drawing a first fluid into a fluid conduit coupled to the stream
6 selection device;
7 the reagent cartridge having a reagent reservoir containing a reagent;
8 loading the reagent cartridge onto a cartridge support of a reagent
9 cartridge assembly;
10 positioning a stream selection device to a second position with the
11 stream selection device being in fluid communication with the reagent cartridge;
12 moving the first fluid into the reagent reservoir with the first reagent
13 to form a reagent solution;
14 moving a first portion of the reagent solution into a holding member
15 in fluid communication with the stream selection device;
16 positioning the stream selection device to a third position with the
17 stream selection device in fluid communication with a fluid sample;
18 drawing the fluid sample to the holding member with the fluid
19 sample adjacent to and in fluid communication with the first portion of the reagent
20 solution so the fluid sample and the reagent solution mix;
21 moving the stream selection device to a fourth position in fluid
22 communication with a detector and with the holding coil;
23 moving the mixed fluid sample and reagent solution as a unit to the
24 detector; and
25 analyzing the mixed fluid sample and reagent solution with the
26 detector.

1 33. The method of claim 32 wherein the reagent cartridge
2 includes a machine-readable symbology with information about the reagent, and
3 further comprising reading the symbology with a symbology reader and providing
4 the information about the reagent from the symbology reader to a controller
5 operatively connected to the stream selection device, selecting via the controller a

6 test sequence based upon the information about the reagent, and controlling the
7 stream selection device based upon the test sequence to analyze the sample.

1 34. The method of claim 32, wherein the reagent in the reagent
2 cartridge is a lyophilized reagent, and further including reconstituting the
3 lyophilized reagent with the first fluid within the reagent reservoir before moving
4 the reagent out of the reagent cartridge.

1 35. The method of claim 34 wherein reconstituting the
2 lyophilized reagent includes moving the first fluid back and forth in the reagent
3 cartridge to mix with the reagent.

1 36. The method of claim 34 wherein reconstituting the
2 lyophilized reagent includes moving the stream selection device to a fifth position
3 in fluid communication with a gas source and the reagent reservoir, and bubbling a
4 gas from the gas source into the reagent reservoir to mix the first fluid and the
5 reagent.

1 37. The method of claim 34 further comprising removing the
2 reagent cartridge from the cartridge support and positioning a second reagent
3 cartridge on the cartridge support and in fluid communication with the stream
4 selection device, the second reagent cartridge having a second reagent reservoir
5 and a second reagent in the reagent reservoir.

1 38. The method of claim 32, further comprising mixing the
2 reagent with the first fluid in the reagent reservoir before the reagent is moved to
3 the detector.

1 39. A method of performing a medical diagnostic test by
2 analyzing a selected samples using a real-time, flow-based analysis, comprising:
3 collecting a fluid sample for analysis in a real time, medical
4 diagnostic test
5 positioning a stream selection device in a first position in fluid
6 communication with a first fluid source for use in the medical diagnostic test;
7 drawing a first fluid into a fluid conduit coupled to the stream
8 selection device;
9 the reagent cartridge having a reagent reservoir containing a reagent;
10 loading the reagent cartridge onto a cartridge support of a reagent
11 cartridge assembly;
12 positioning a stream selection device to a second position with the
13 stream selection device being in fluid communication with the reagent cartridge;
14 moving the first fluid into the reagent reservoir with the first reagent
15 to form a reagent solution;
16 moving a first portion of the reagent solution into a holding member
17 in fluid communication with the stream selection device;
18 positioning the stream selection device to a third position with the
19 stream selection device in fluid communication with the fluid sample;
20 drawing the fluid sample to the holding member with the fluid
21 sample adjacent to and in fluid communication with the first portion of the reagent
22 solution so the fluid sample and the reagent solution mix;
23 moving the stream selection device to a fourth position in fluid
24 communication with a detector and with the holding coil;
25 moving the mixed fluid sample and reagent solution as a unit to the
26 detector;

27 analyzing the mixed fluid sample and reagent solution with the
28 detector to obtain results from the medical diagnostic test.

1 40. The method of claim 39 wherein the fluid sample is collected
2 during a selected medical procedure on patient, and analyzing the mixed fluid
3 sample and reagent solution occurs before the medical procedure on the patient is
4 completed.

1 41. The method of claim 39, further including mixing the reagent
2 with the first fluid when the reagent is within the reagent reservoir.

1 42. The method of claim 39, further comprising removing the
2 reagent cartridge from the cartridge support and positioning a second reagent
3 cartridge on the cartridge support and in fluid communication with the selector
4 valve, the second reagent cartridge having a second reagent reservoir and a second
5 reagent in the reagent reservoir.